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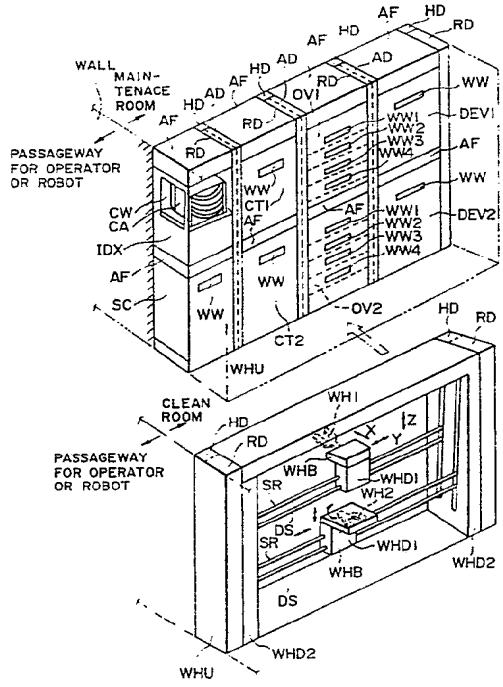
(54) Workpiece processing apparatus

(57) A workpiece processing apparatus usable, e.g., in semiconductor device manufacturing processes, comprises a plurality of component units at least two of which are stacked vertically (SC, CT1, CT2, IDX, OV1, OV2, DEV1, DEV 2) and a hand (WH1, WH2) for moving a workpiece between the units. Transfer of a workpiece between different component units is made by moving the hand in accordance with a sequence of processing steps. The apparatus includes component units such as a resist film coating station, a developing station, an oven station, a cleaning station, a deep ultraviolet light irradiating station, a film thickness measuring station, a development result examining station, and a workpiece (wafer) cassette bearing station. An auxiliary hand may be provided in the coating station. The arrangement reduces the area of floor occupied and improves the adaptability of the apparatus to various processing operations.



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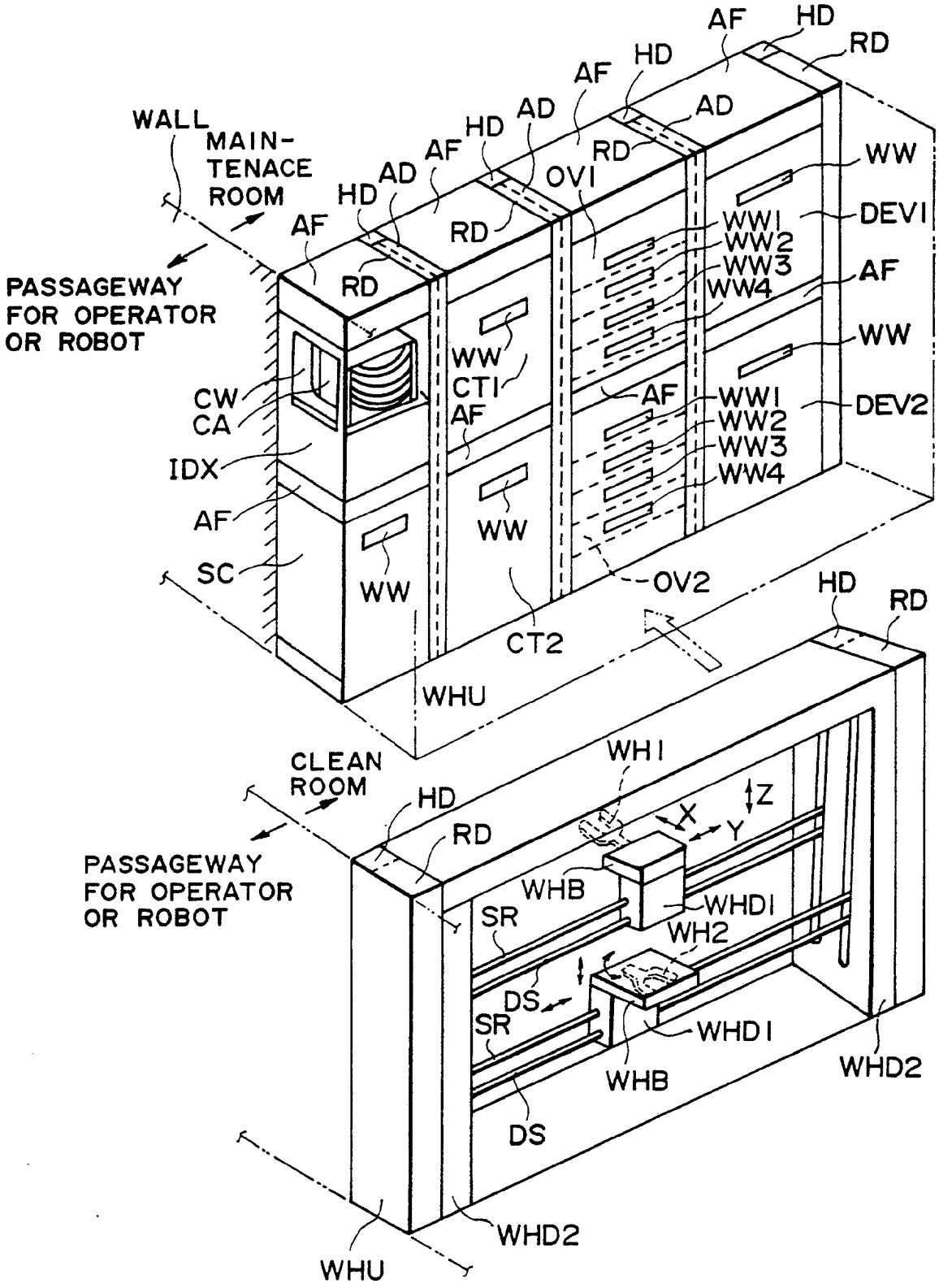
WALL
MAIN-
TENACE
ROOM
PASSAGEWAY
FOR OPERATOR
OR ROBOT
CW
CA
IDX
AF
SC
WW
CTI
AF
WW
CT2
WHU
OV1
OV2
WW1
WW2
WW3
WW4
DEV1
DEV2
HD
RD
AD
CLEAN
ROOM
PASSAGEWAY
FOR OPERATOR
OR ROBOT
WH1
X
Y
Z
WHB
WHD1
WH2
SR
DS
WHD2

FIG. 1

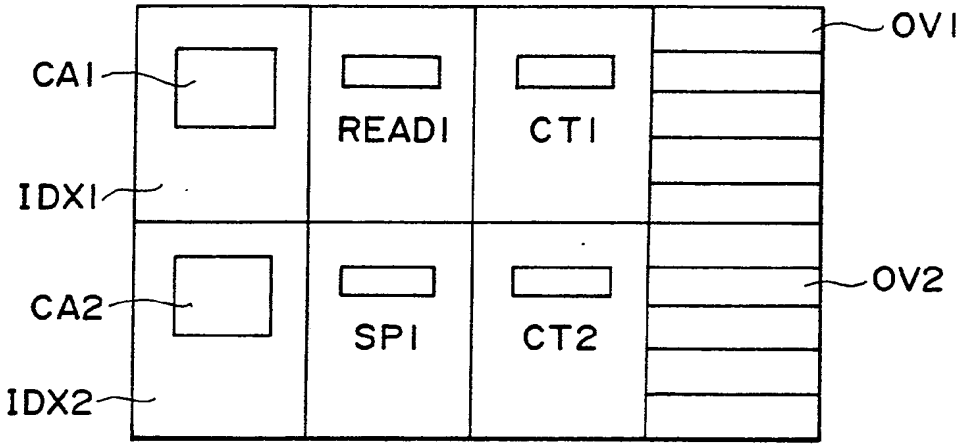
OV1
CA1
READ1
CT1
IDX1
CA2
SP1
CT2
OV2
IDX2

FIG. 3

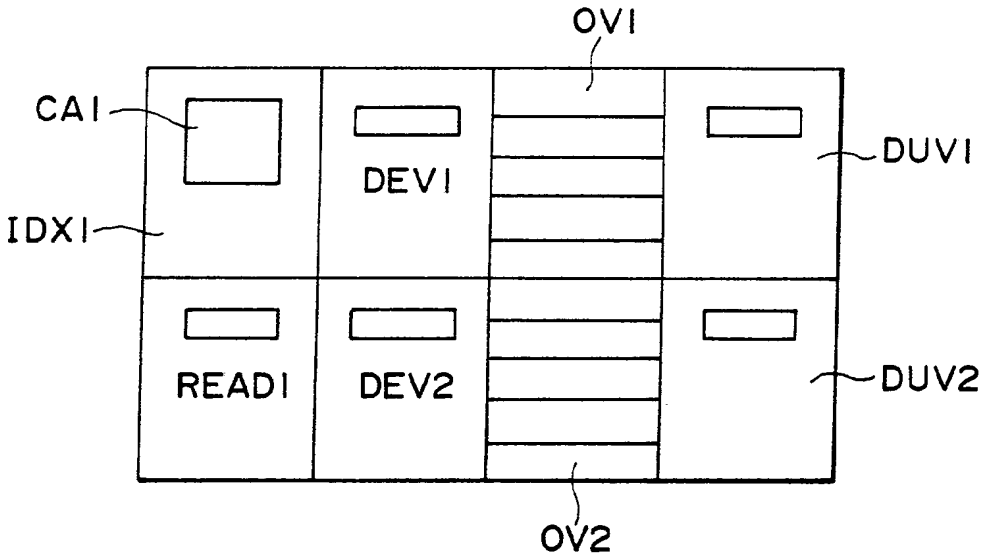
OV1
CA1
DEV1
DUV1
IDX1
READ1
DEV2
DUV2
OV2

FIG. 4

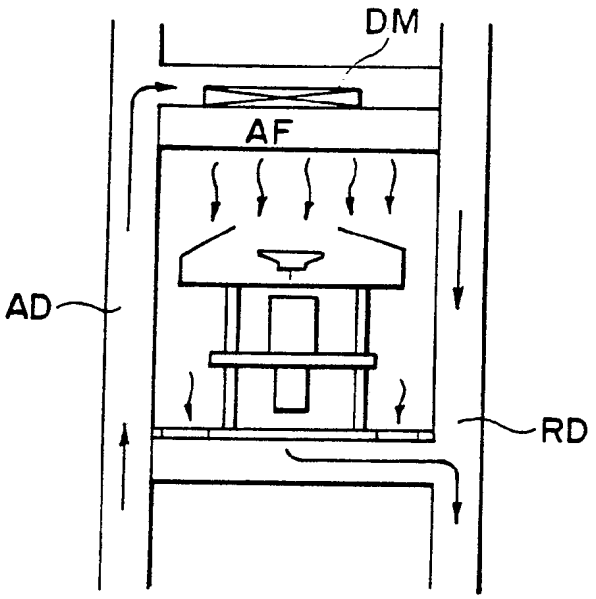
DM
AF
AD
RD

FIG. 2

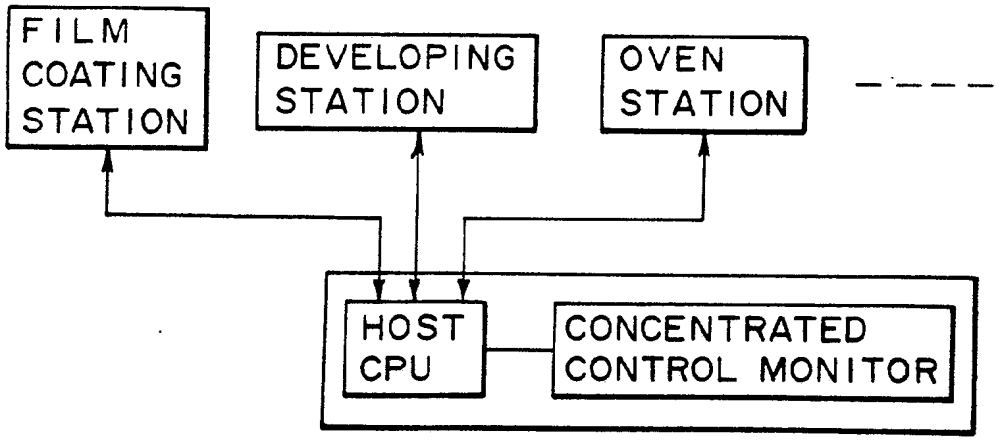
FILM COATING STATION
DEVELOPING STATION
OVEN STATION
HOST CPU
CONCENTRATED CONTROL MONITOR

FIG. 5

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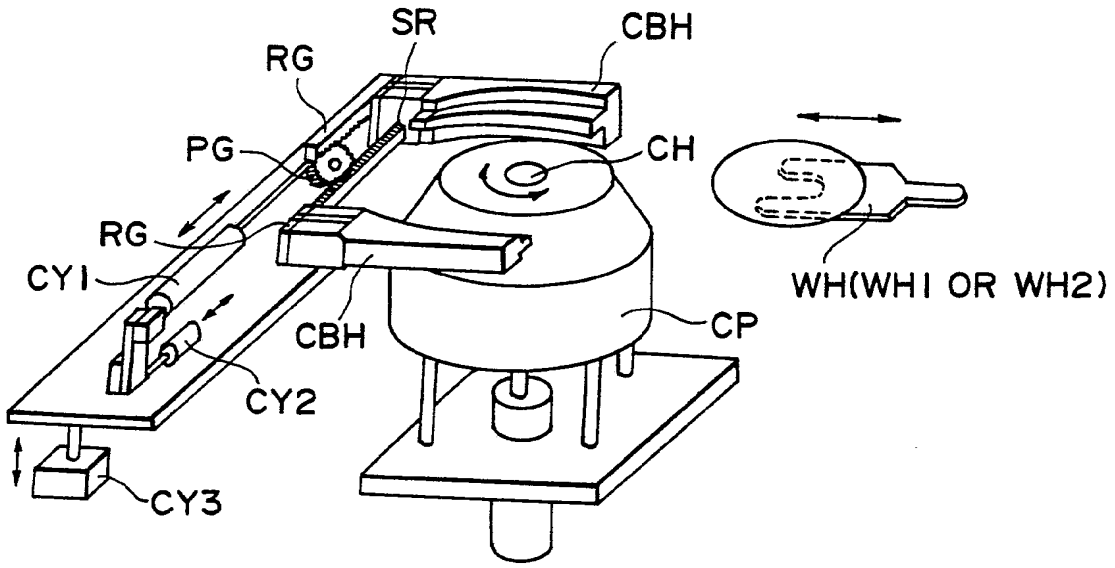

FIG. 6A

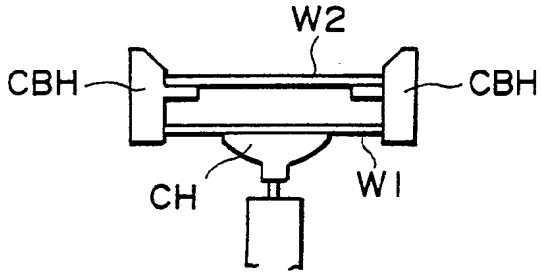

FIG. 6B

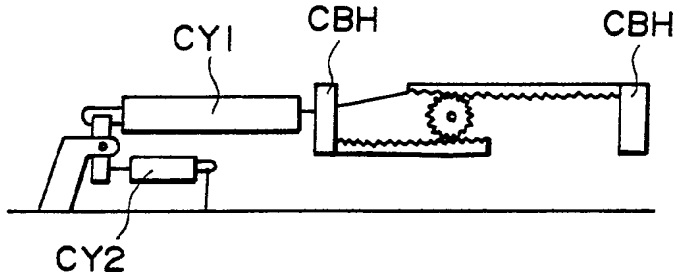

FIG. 6C

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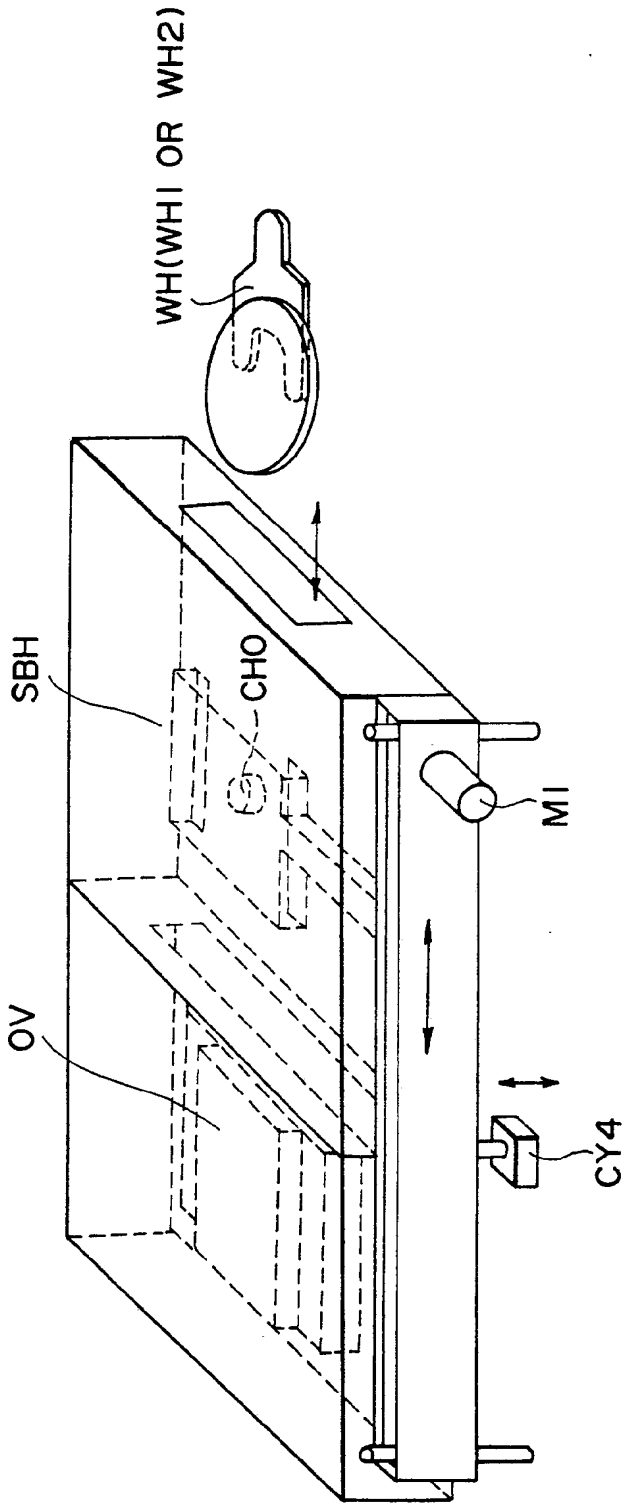

FIG. 7

SE1	SE2	PEB	DEV	DPB	RE1	RE2
SE1	SE2	PEB	DEV	DPB	RE1	RE2
SE1	SE2	DB	CT	CPB	RE1	RE2
OP						

FIG. 8

B_7	B_8	CT	OVEN	R	R
B_6	B_5	OVEN	SOGCT	B_4	B_3
S	S	CT	OVEN	B_1	B_2

FIG. 9

WORKPIECE PROCESSING APPARATUS

FIELD OF THE INVENTION AND RELATED ART

This invention relates to a workpiece processing apparatus for processing workpieces such as semiconductor wafers, for example. As an example, the invention is applicable in semiconductor microcircuit manufacturing processes to a device for forming, by coating, a resist film for photolithography, a device for developing a resist film after exposure, a device for forming, by coating, a film for impurity doping to a wafer, a device for forming, by coating, a passivation film or an interlaying insulative film between layers of a chip on a wafer.

Figure 8 is a plan view showing an example of layout of a semiconductor device manufacturing system of known type, wherein a coating station, an oven station, a developing station and a wafer cassette bearing station are disposed in a horizontal plane. In Figure 8, denoted at SE1 and SE2 are wafer cassette bearing stations at a wafer supply side; at PEV is an oven station for strengthening an exposed resist film; at DB is an oven station for removing moisture content of a wafer prior to the resist coating; at DEV is a developing station; at CT is a resist coating station; at DPB is an oven station for contracting a developed resist; at CTB is an oven station for drying an applied

resist; at RE1 and RE2 are wafer cassette bearing stations at a wafer collection side; and at OP is an operation panel.

SUMMARY OF THE INVENTION

In conventional workpiece processing apparatuses of the type described above, the components of the apparatus are disposed along a horizontal plane and, for this reason, there is a disadvantage that a large area of the floor of an expensive clean room of a semiconductor device manufacturing factory is occupied by the processing apparatus. Also, since the components are disposed in a line in accordance with the procedure to be made, each component is used independently of the others such that it is difficult to assure reduction in cost or dimension of the apparatus by using elements in common. Additionally, since the structure is determined by a used procedure, the adaptability to different procedures is low. This is an inconvenience.

In consideration of the problems involved in the conventional apparatuses described above, it is an object of the present invention to provide a workpiece processing apparatus which requires a smaller area of a floor to be occupied by the apparatus, which allows reduction in cost or dimension of the apparatus as a whole, and which has a large adaptability to meet

various procedures.

Additionally, it is intended that a workpiece processing apparatus is structured so that a clean air or a temperature-controlled clean air can be supplied to each component of the apparatus and, on the other hand, only a portion which is serviceable in transfer of a workpiece to or from another apparatus placed in the clean room, opens to the clean room and, additionally, the apparatus as a whole can be placed outside the clean room, to thereby ensure notable reduction in the area within the clean room to be occupied by the apparatus.

In order to achieve one or both of these objects, a workpiece processing apparatus according to an aspect of the present invention includes some of plural components such as a film coating station, a developing station, an oven station, a cleaning station, a deep ultraviolet light irradiating station, a film thickness measuring station, a development result examining station, a workpiece identification symbol reading station, a workpiece cassette bearing station and the like, wherein some of used components are disposed accumulatingly along a vertical plane.

This makes it possible to reduce the area of a floor to be occupied.

The conveyance of a workpiece such as a wafer into or out of each component may preferably be made by

using a wafer handler, for example. Also, it is convenient that the sequence for conveyance of workpieces into or out of different components can be set as desired in accordance with a procedure comprising a series of steps which can be combined as desired. Alternatively, it is convenient that a plurality of different procedures are set so that they are executed at the same time or interchangeably.

Additionally, the structure may preferably be such that a clean air cleaned by a clean filter is supplied to each component.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view showing a general structure of a workpiece processing apparatus according to an embodiment of the present invention.

Figure 2 is a fragmentary section showing a duct AD, a filter AF, an exhaust duct RD and the like used in the apparatus shown in Figure 1.

Figures 3 and 4 are front elevational views, respectively, each showing a general structure of a

workpiece processing apparatus according to another embodiment of the present invention.

Figure 5 is a block diagram showing an example of disposition of a concentrated control monitor HC within a control room.

Figures 6A - 6C illustrate the provision of an auxiliary hand in a coating device of the Figure 1 apparatus, wherein Figure 6A is a perspective view, Figure 6B is a sectional view and Figure 6C is a side view.

Figure 7 is a perspective view showing one unit of an oven station of the Figure 1 apparatus.

Figures 8 and 9 are plan views, respectively, each showing an example of conventional semiconductor device manufacturing system wherein the components thereof are disposed along a horizontal plane.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 is a perspective view showing a general structure of a workpiece processing apparatus according to an embodiment of the present invention. This embodiment is an example wherein a workpiece processing apparatus of the present invention is applied to a semiconductor device manufacturing system. In Figure 1, denoted at AD is an intake duct for introduction of a clean air or a temperature-controlled air; at AF is a filter for additional cleaning of the

supplied air; at RD is a collection or exhaust duct for collecting or exhausting the clean air; at HD is a duct for wiring or piping; and at IDX is a wafer cassette bearing station which includes a carrier CA on which a wafer cassette is placed. The carrier CA includes a stage mechanism for rotating a wafer cassette about a vertical axis. Also, the wafer cassette bearing station IDX may comprise a cassette elevator which is movable in a vertical direction (z-axis direction). Alternatively, it may be structured so that wafers kept accumulatingly within a wafer cassette, placed at the wafer cassette bearing station IDX, are taken out one by one along with vertical movement (in the z-axis direction) of a hand WH of a handler unit WHU (which will be described later).

Denoted at SC is a wafer cleaning unit; and at CT1 and CT2 are coating devices each being adapted to coat the whole surface of a wafer with a resist material by dropping drops of resist material upon the surface of a rotating wafer so that the resist is applied to the wafer surface through a centrifugal force. Denoted at OV1 and OV2 are oven stations each being adapted to heat a resist-coated wafer.

In this embodiment, each oven station OV1 or OV2 is provided with four independent hot plates. One of them may be used as a cooling plate for forcibly cooling a wafer. Denoted at DEV1 and DEV2 are

developing devices each for developing a resist of a wafer having been exposed (photoprinted) by means of an exposure apparatus (not shown). Denoted at WW and WW1 - WW4 are openings each being provided for introduction or extraction of a wafer to a corresponding component. Denoted at CW is an opening for introduction or extraction of a carrier (wafer cassette).

The components described above are disposed along a direction perpendicular to the floor which supports the semiconductor device manufacturing system, namely, along a vertical plane (x-z plane) so that, as illustrated, each two components are stacked in a vertical direction (z-axis direction) while each four components are placed in an array in a horizontal direction (y-axis direction). Also, at the top of each component, there is provided one filter AF. Further, at each interspacing between adjacent components arrayed in the horizontal direction (y-axis direction), there is provided a duct means AD, RD or HD. The wafer cassette bearing station IDX is disposed above the wafer cleaning unit SC and has its carrier introducing/extracting opening formed in communication with a passage way for an operator or a robot. The coating devices CT1 and CT2 are disposed in an array extending in the vertical direction (z-axis direction), in a manner that the coating device CT1 rests by the wafer cassette bearing station IDX while the coating

device CT2 rests by the wafer cleaning unit. Similarly, the oven stations OV1 and OV2 are stacked to rest by the coating devices CT1 and CT2, respectively, while the developing devices DEV1 and DEV2 are stacked to rest by the oven stations OV1 and OV2, respectively. The back of each component (the surface opposite to the face in which corresponding one of wafer introducing/extracting openings WW and WW1 - WW4 is formed) faces toward a maintenance room.

Reference character WHU denotes the whole of a handler unit which is operable to transfer a wafer between different components. The handler unit WHU is provided at the clean room side and, as depicted by dash-and-dot lines, it is disposed to be opposed to the components disposed along a vertical plane as described hereinbefore. Denoted at WH1 and WH2 are hands each being adapted to introduce or take out a wafer into or from a selected component. Also, each hand is adapted to transfer a wafer between different components. Each hand is movable forwardly and backwardly; leftwardly and rightwardly; and upwardly and downwardly, as depicted by arrows X, Y and Z. Where a plurality of hands are provided, as in the present embodiment, the structure is made to avoid mechanical interference of those hands.

The motion of each hand WH1 or WH2 in a forward or backward direction (in a direction of arrow

X) is provided by a hand mechanism WHB which has a box-like structure that can accommodate a wafer. Denoted at WHD1 is a hand drive mechanism for moving corresponding one of the hands WH1 and WH2 leftwardly or rightwardly (in a direction of arrow Y). The hand drive mechanism WHD1 is adapted to move the hand WH1 or WH2 along a sliding guide means SR, by using a drive ball screw DS. Denoted at WHD2 is a vertical drive mechanism for moving the hands WH1 and WH2, together with their sliding guide means SR and drive ball screws DS, upwardly or downwardly (in a direction of arrow Z).

Each component (unit) has its opening for wafer extraction (such as at WW, for example) faced in one orientation, at a side at which the hands WH1 and WH2 are provided. However, with regard to the leftmost and rightmost units, if there are any wafer conveying machines at the left and right sides, additional openings may be provided in such portions.

By means of the intake duct AD, the filter AF and the exhaust duct RD, in each component it is possible to obtain sufficient cleanness constantly.

Figure 2 is a fragmentary section showing the intake duct AD, the filter AF, the exhaust duct RD and the like used in the Figure 1 apparatus. An air (which may be a temperature-controlled air) is supplied from the duct AD through the air filter AF to each unit, as depicted by arrows. In this occasion, as illustrated,

a fan motor DM may be provided above the air filter AF. The structure is adapted so that the air passes through the unit in a laminar flow fashion. Also, the structure is arranged so that the air is collected at the exhaust duct RD. Additionally, the wiring and piping duct is separated from the ducts AD and RD, and is prepared at the behind of the ducts AD and RD. In that portion, no specific blowing exhaustion is made.

Further, in each of the oven stations OV1 and OV2, the temperature of each oven (heater) can be set as desired. Two heaters may be used for pre-baking while the other two may be used for post-baking.

Description will now be made of the procedure in a coating process and a developing process, using the apparatus of the present embodiment.

First, in a wafer coating process, a wafer is taken out of a carrier CA placed at the wafer cassette carrying station IDX, by means of the hand WH (hand WH1 or WH2). Then, if the wafer cleaning is necessary, the extracted wafer is conveyed to the wafer cleaning unit SC and is cleaned thereat. After this, it is picked up by the hand WH from the wafer cleaning unit SC, and it is conveyed to the oven OV2 and is dried therein. In this manner, by means of the hand WH of the handler unit WHU, the wafer can be conveyed to different processing units in sequence. After the drying, it is subjected to the film coating by the coating device CT1

and, then, to the sintering in the oven OV1. If further coating is necessary, the wafer is subjected again to the film coating in the coating device CT2 and, after being sintered again by the oven OV1, it moves back to the carrier CA.

Thereafter, the wafer is taken out of the carrier CA and is subjected to the exposure process at an exposure unit which is provided outside the processing apparatus, and then it is conveyed back to the carrier CA.

For the developing process, an exposed wafer is again taken out by the hand WH and is conveyed to the developing unit DEV1 or DEV2 and is subjected to the development. After the development, the wafer is conveyed again by the hand WH into the oven OV1 or OV2 for sintering and, thereafter, it is conveyed back to a final carrier CA. By this, all the processes are completed.

While the present embodiment has been explained with reference to an example of layout of units including spin type devices and baking devices for use in photolithography, the invention is not limited to the described example but is applicable also to any other forms. For example, in regard to the layout of units comprising an etching device, a CVD (chemical vapor deposition) device and the like, a similar structure can be used.

Additionally, while the Figure 1 apparatus has a structure that includes a cleaning station SC, a coating station CT, oven stations OV1 and OV2 and developing stations DEV1 and DEV2, this may be modified such as illustrated in Figure 3. Namely, in this example, in a lower array there are provided a wafer cassette bearing station IDX2, a film thickness measuring station SP1, a coating station CT2 and an oven station OV2 (in the named order from the left) while in an upper array there are provided a wafer cassette bearing station IDX1, a workpiece identification symbol reading station READ1, a coating station CT1 and an oven station OV1 (in the named order from the left). The remaining portion of the structure is similar to that of the Figure 1 embodiment.

In operation of the apparatus of the Figure 3 example, a first wafer is taken out of a carrier CA1 and is introduced into the workpiece identification symbol reading station READ1. Then, the content of an identification symbol of the first wafer is read and the recognition is made to that the wafer is a test wafer. Thereafter, it is conveyed to the coating station CT1 and then to the film thickness measuring station SP1 via the oven station OV1. At the film thickness measuring station SP1, the film thickness is measured and, if the film thickness is within a predetermined tolerance, it is determined that the

processing of a second wafer and wafers following it can be initiated and, therefore, such a processing is made. If the film thickness of the test wafer is out of the tolerance, the number of revolutions per unit time of a wafer upon application of a resist material at the coating station CT1 is changed automatically, and after this, the processing of the second wafer and the wafers following it is conducted. Also, upon transition to the processing of the second wafer, and on the basis of the reading at the workpiece identification symbol reading station READ1, whether or not a wafer should be conveyed along a passageway from CT1 via OV2 and CT2 to OV2 or a passageway from CT1 via OV1 or CT2 to OV2, is discriminated and the wafer processing is made accordingly.

Where the structure is such as shown in Figure 4 wherein in a lower array there are provided a workpiece identification symbol reading station READ1, a developing device DEV2, an oven station OV2 and a deep ultraviolet ray irradiating station DUV2 (in the named order from the left) while in an upper array there are provided a wafer cassette bearing station IDX1, a developing device DEV1, an oven station OV1 and a deep ultraviolet ray irradiating station DUV1 (in the named order from the left) the operation will be such as described below.

First, a first wafer is taken out of a carrier

CA1 and is introduced into the workpiece identification symbol reading station READ1. Then, the content of an identification symbol of the first wafer is read, and discrimination is made has to whether a wafer should be conveyed and processed (i) in an order from DEV1 or DEV2 via OV1 or OV2 to DUV1 or DUV2, or (ii) in an order from DEV1 or DEV2 to OV1 or OV2, only, and the wafer processing is made accordingly. In this occasion, the stations denoted at DUV1 and DUV2 each is a deep ultraviolet ray irradiating station which is provided for enhancing heat resistivity of a pattern having been subjected to the developing process. Also, each of the developing stations DEV1 and DEV2 has contained therein a development result examining portion (development termination detecting portion), and include a portion adapted to execute optical detection to ensure optimum development of each wafer.

In the apparatus of the present embodiment, by manipulation by an operator, a procedure comprising any combination of sequential operations can be set as desired. In accordance with such a procedure, a host computer (see Figure 5) controls the wafer introduction/extraction sequence. Examples of procedures that can be designated by the operator are such as follows:

(1) A wafer within a carrier CA placed at an indexer IDX is moved and processed in the following

order:

"From Carrier CA via Coating Station CT1 and Oven Station OV1 to Carrier CA"

This is an example that a processing in which only baking is made after the coating, is designated.

(2) A wafer within a carrier CA placed at an indexer IDX is moved and processed in the following order:

"From Carrier CA to Coating Station CT1 and then to Oven Station OV1 then to Coating CT2 and then to Oven Station OV2 and to Carrier CA"

(3) A wafer within a carrier CA placed at an indexer IDX is moved and processed in the following order:

"From Carrier CA to Cleaning Station SC and then to Oven Station OV2 then to Coating Station CT1 and then to Oven Station OV1 and to Carrier CA"

(4) A wafer within a carrier CA placed at an indexer IDX is moved and processed in the following order:

"From Carrier CA to Developing Station DEV1 or DEV2 and then to Oven Station OV1 or OV2 and to Carrier CA"

As described, by manipulation by an operator, a desired sequence of wafer processing can be designated and the host computer conducts the wafer processing in accordance with the designated procedure.

Additionally, in the apparatus of the present embodiment, a plurality of different procedures each comprising a series of operations can be set and they can be conducted in parallel to each other or interchangeably. For example, where a plurality of carriers are provided, if different procedures are set so that (i) a wafer in a carrier A is conveyed and processed from the coating station CT1 via the oven station OV1 while (ii) a wafer within another carrier B is conveyed and processed from the developing station DEV1 or DEV2 via the oven station OV2, it is possible to proceed the wafer processing with automatic conveyance of wafers kept in the carriers by means of the hands WH1 and WH2, under the influence of the host computer which discriminates a ready state or busy state of each unit.

On the other hand, as shown in Figure 5, the concentrated control monitor by which various portions of the apparatus of the present embodiment are controlled concentratingly, may be disposed within a control room (a room separate from a space in which the apparatus is provided) while retaining connection with the host computer (CPU) so that it is used for the control monitoring.

Additionally, each component may be provided with an auxiliary hand. Figures 6A - 6C are a perspective view, a sectional view and a side view,

respectively, showing a portion of the Figure 1 apparatus in which the coating device CT1 is provided with an auxiliary hand.

In Figures 6A - 6C, denoted at WH is a primary hand such as described in the foregoing; at CH is a chuck; at CP is a cup; at CBH is an auxiliary hand; at SR is a sliding rail; at RG is a rack gear; at PG is a pinion gear; at CY1 - CY3 are cylinders; and at W1 and W2 are wafers. The cylinder CY2 is fixed to a base as illustrated in Figure 6C, while the cylinders CY1 and CY2 are linked.

The auxiliary hand of this example has a wafer centering function as well as a wafer buffering function. More specifically, as illustrated in Figure 6B, The upper portion of the auxiliary hand CBH provides a buffering zone, and a processed wafer W2 can be held. Also, with this hand, when an unprocessed wafer W1 is placed on the chuck CH, it is possible to execute the centering thereof.

First, in operation, a processed wafer W2 placed on the chuck CH is pushed by the chuck upwardly as viewed in the sheet of the drawing. Thereafter, the cylinder CY1 is contracted and, by the cooperation of the rack gear RG and the pinion gear PG, the interval between two arms of the auxiliary hand CBH is reduced. Then, by lowering the chuck CH, the wafer W2 is placed on the auxiliary hand CBH. After this is completed, by

using the cylinder CY3 the auxiliary hand CBH is moved upwardly as viewed in the drawing. By this, the buffering of the wafer W2 is attained.

Subsequently, an unprocessed wafer W1 is introduced onto the cup CP by the hand WH. Then, again the chuck CH moves upwardly so that the wafer W1 is transferred onto the chuck CH. The hand WH is temporally retracted away from the cup CP. At this time, the cylinder CY2 is contracted, whereby through the cylinder CY1 linked thereto the arms of the hand CBH are closed slightly, with a result that the center of the wafer W1 becomes exactly coincident with the center of the chuck. Figure 6B shows that state.

Subsequently, the chuck CH attracts the wafer W1 thereto by vacuum suction. Then, the cylinder CY2 operates again to slightly open the auxiliary hand CBH, and the chuck CH moves downwardly while holding the wafer W1 by attraction. Then, the hand WH is again projected to the above of the cup CP and, thereafter, by the cylinder CY3 the auxiliary hand CBH is moved downwardly so as to transfer the wafer W2 onto the hand WH. The hand WH retracts again, for transition to the next process. At the same time, the cylinder CY1 opens and the auxiliary hand CBH moves away from the cup CP, such that, in this state, the processing of the wafer W1 can be initiated.

Figure 7 shows one unit of the oven station

(e.g. OV1) of the Figure 1 apparatus. This is an example wherein an auxiliary hand is provided within the oven and wherein, in order to prevent over-baking of a wafer, by using the auxiliary hand the wafer is taken out of a heating chamber having a hot plate after elapse of a predetermined time.

In Figure 7, when an oven chuck CHO receives a wafer from a hand WH, a cylinder CY4 is actuated to move upwardly an auxiliary hand unit as a whole, such that the wafer is transferred onto an auxiliary hand SBH. The auxiliary hand SBH is moved leftwardly by the drive of a motor M1 to introduce the wafer onto an oven OV. By downward movement of the unit as a whole by the cylinder CY4, the wafer is placed on the oven OV. Then, the auxiliary hand SBH is moved back to its initial position by the drive of the motor M1. After the baking in the oven OV for a predetermined time, the auxiliary hand SBH operates in an inverse order to move the wafer back to the oven chuck CHO.

In an occasion where the coating process by using a spin type coating device partially overlaps with any other process such as baking or otherwise, a transverse disposition structure requires an extraordinarily large area to be occupied by the apparatus, as illustrated in Figure 8. However, with the arrangement as of the present embodiment, the apparatus can be structured in a vertically extending

form and, therefore, it can be disposed in a limited small area. As a result, reduction in the area to be occupied by the apparatus is attained.

Further, the conventional transverse disposition structure involves limitations an example of which is that, if in an arrangement such as shown in a plan view of Figure 9 it is desired to use an SOGCT (spin-on-glass-coater) only, buffering stations B3 and B4 have to be used as a sender while buffering stations B5 and B6 have to be used as a receiver. With the arrangement of the present embodiment, however, there is no such limitation, and, even if it is desired to change the process in the course of the same, the wafer supply from the same carrier station is possible.

In accordance with the arrangement of the apparatus of the present embodiment, there is no unuseful buffer station (such as at B1 - B8 in Figure 9) and also there is no necessity of provision of a hand means between adjacent units (e.g. between units S and CT in Figure 9). As a result, the reduction in cost is attainable. Additionally, since the structure of the apparatus itself enhances the cleanness, the cost of a user's clean room can be reduced.

Moreover, since in each unit the cleanness or temperature of a desired portion can be controlled locally, it is possible to ensure constant conditions with certainty. Further, since a wafer when it is

handled is conveyed while being kept in a container, there is only a very small possibility of adhesion of foreign particles to the wafer.

In accordance with the present invention, as described hereinbefore, various components of a workpiece processing apparatus are disposed in a vertical direction and, for this reason, the area of a floor to be occupied by the apparatus can be reduced and the cost or dimension of the apparatus as a whole can be reduced.

Also, even within such a clean room as having a relatively low cleanness, the apparatus of the present invention can retain high cleanness and, therefore, it is possible to reduce contamination of wafers.

Moreover, the adaptability in regard to the processing procedure can be improved significantly, which makes it possible and practicable to use the apparatus for multiple purposes particularly in such a factory for small-amount production of multiple items or in such a factory or institution in which studies or trial production of semiconductor devices are to be made.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as

may come within the purposes of the improvements or the scope of the following claims.

WHAT IS CLAIMED IS:

1. An apparatus for processing a workpiece such as a semiconductor wafer, comprising:

a plurality of component units including a cassette carrying unit for carrying thereon a cassette for accommodating a plurality of workpiece;

a moving mechanism for moving a workpiece between different component units; and

a control device for controlling said moving mechanism;

wherein said component units or at least two of said component units are stacked along a vertical plane.

2. An apparatus according to Claim 1, wherein said component units include at least one of a resist coating unit, a resist developing unit, a cleaning unit, a deep ultraviolet light irradiating unit, a film thickness measuring unit, a development result examining unit and a workpiece identification symbol reading unit.

3. An apparatus according to Claim 1, wherein said moving mechanism includes a hand mechanism for holding a workpiece and being movable between different component units while holding the workpiece.

4. An apparatus according to Claim 3, wherein said hand mechanism includes a workpiece storing casing and wherein, when said hand mechanism moves a workpiece between different component units, the workpiece is accommodated in said casing.

5. An apparatus according to Claim 3, wherein said hand mechanism is movable along a predetermined vertical plane and wherein each of said component units has an opening for allowing introduction or extraction of a workpiece, which opening is opposed to said predetermined vertical plane.

6. An apparatus according to Claim 3, wherein each of said component units is provided with an auxiliary hand mechanism for transfer of a workpiece to or from said hand mechanism.

7. An apparatus according to Claim 1, wherein said moving mechanism includes a plurality of hand mechanism each being adapted to hold a workpiece and to move between different component units while holding the workpiece.

8. An apparatus according to Claim 1, wherein said control device is arranged to allow that the sequence of conveyance of a workpiece by said moving

mechanism to or from different component units is set as desired in accordance with a procedure of sequential processes.

9. An apparatus according to Claim 1, wherein said control device is adapted to allow that a plurality of sequences for conveyance of a workpiece by said moving mechanism are set and that the set sequences are executed in parallel to each other or interchangeably.

10. An apparatus according to Claim 1, wherein a duct is provided between different component units and wherein each of said different component units is supplied with an air flowing through said duct and through a clean filter.

11. An apparatus for processing a workpiece such as a semiconductor wafer, comprising:

a plurality of component units including a cassette carrying unit for carrying thereon a cassette for storing therein a plurality of workpieces, a coating unit for coating a workpiece with a resist, and an oven unit for heating a workpiece;

a moving mechanism including a hand mechanism for holding a workpiece, said moving mechanism being adapted to move a workpiece held by said hand mechanism

between different component units; and

a control device for controlling said moving mechanism so that a workpiece is moved between different component units by said hand mechanism in accordance with a sequential processes to be made for the workpiece.

12. An apparatus according to Claim 11, wherein said component units are stacked in a vertical direction in two horizontal arrays, each array including plural component units.

13. Apparatus for processing a workpiece comprising a plurality of units between which a workpiece may be moved during a processing operation, and means to move a workpiece between said units, the units being provided in an upwardly extending substantially planar array.

14. Apparatus for processing a workpiece comprising a plurality of units between which a workpiece may be moved during a processing operation, means to move a workpiece between said units, and control means which control the moving means to move a workpiece between said units in a sequence determined by the sequence of processes to be carried out on the workpiece in the processing operation.

15. Apparatus for processing a workpiece substantially as herein described with reference to Figures 1 to 7 of the accompanying drawings.

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